IMPROVING EFFECTIVENESS IN POLICING THROUGH THE USE OF COMPUTER TECHNOLOGY

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ABSTRACT

This paper discusses how computer technology has improved police performance. Automated criminal history systems provide complete histories of criminals, thereby improving arrest rates and the adjudication process. Automated fingerprint identification systems have had a significant impact in the area of criminalistics. Computer simulation has aided the police in manpower allocation, workload requirements, and training programs. Robots are being used by the police for bomb disposal, and are being considered for patrol duties, special surveillance situations, and in prisons.

Human factors has impacted the police in many ways and in many areas. Some of these areas include the polygraph and voiceprint analyzer for determining the truthfulness of statements made by suspects (Murphy, 1980; Nash & Tosi, 1971), firearms systems, nonlethal weapons systems such as stun guns (Mainhardt, 1970; Parsons, 1974), gas guns (Swearengen, 1972) and "Tasers" (Robinson, 1985), and fiberglass/kevlar body armor (Williams, 1971 & 1973). One area of policing in which human factors engineering is having a major impact is in the use of computers by police. Almost all police departments have at a very minimum micro-computer systems, and most of the larger departments have large main-frames. Virtually every police agency in the country has a direct computer link with the Federal Bureau of Investigation's National Crime Information Center (NCIC) and their own state Crime Information Center (CIC). This paper will focus on four areas of police use of computers; automated criminal history systems, fingerprint identification, computer simulation, and robots.

Computers in police work have a very short history. It was not until the 1960's that computers first appeared in policing, and these appeared only because of the federal money provided departments by the Law Enforcement Assistance Administration (LEAA). In fact, Chicago, Illinois Police Department was the first metropolitan police department in the country to use a computer (Zurawski, 1979), followed by the Metropolitan Police Department of Nashville and Davidson County, Tennessee (Maynard, 1972), which used a UNIVAC 418-III system. These early systems were primarily used for information storage, such as storing lists of wanted ussupects, stolen automobiles and license plates, outstanding warrants and records of stolen property. In essence, they assisted the police administrator more than they did the police officer.

Police agencies require a great deal of information to establish and maintain criminal history records. The sheer quantity of information maintained, including arrests, indictments, and conviction data, reveals inherent problems in the management of this information. However, these problems have been reduced to a great extent with the aid of computer technology. Within the past 15 years, numerous advancements have been made in maintaining criminal history information using computerized networks.

An example of an existing computer network is that of the New Jersey State Police Computerized Criminal History System (CCH), in place since 1972. The system is comprised of a main-frame data base managed and updated by the State Police and approximately 300 remote terminals laced throughout the state in criminal justice agencies.

It is important to note that all inquiries into the CCH system are strictly for criminal justice purposes only. Agencies and individuals authorized to access the system are subject to the requirements set forth in Title 28, Chapter 1, Part 20, Code of the Federal Regulations, Public Law 92-544 and the Privacy Act of 1974.

The criminal history system in New Jersey is actually two computer systems. The first system is referred to as the Master Name Index (MNI), the second is the computerized Criminal History System proper. The MNI contains information such as name, date of birth, sex, and/or social security number. When an inquiry on a specific individual is made, the system searches its stored data and provides the requesting agency with a state certification number (if a criminal history arrest file exists for that individual). Once a state identification number for that individual is obtained, the requesting agency can retreive all available records from the CCH proper. There are three records available in the CCH proper; arrest records, conviction records, and summary records. Information for these inquiries is typically supplied in a matter of seconds using the computer as compared with days if supplied manually.

Information contained in the CCH files is often used to; (1) aid in the identification of offenders who provide false/misleading/incomplete information to an arresting agency, (2) assist a judge in preparing sentences for habitual offenders in cases where the law dictates graduated punishment, and (3) assists in checking of individuals seeking employment in the criminal justice field to insure no criminal history file

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exists for that individual.

Initial entry of information into the data base is accomplished by way of a criminal arrest fingerprint card submitted to the state police by an arresting agency. The data on the fingerprint card (name, date of birth, social security number, arrest date, charges, etc.) is input into the computer, thereby establishing an arrest record. Although the arrest data is important, its value is limited without additional supporting data including, but not limited to, the final adjudication of the charge(s). The mechanism by which this additional data is provided to the state police is the court disposition reporting system (CDR).

The CDR system utilizes eight documents to collect criminal data from criminal justice agencies. These eight documents are; complaint summons, complaint warrants, county prosecutor's disposition report, county clerk's criminal disposition report, couty change of criminal disposition report, probation department report, conditional discharge disposition report (drug charges), and custody supervision status report. Information contained within these documents is added to the data bese and subsequently matched with its respective arrest and fingerprint information.

The fact that there are eight different reporting documents which provide data on any one given crime, is an indication of the enormous amount of data which is stored in the system. The manpower required to manually provide this type of information by locating and removing records from a master file, then duplicating and sending the requested records to the criminal justice agencies would be overwhelming. In addition, several agencies may request the same data within a short period of time, if records are not refiled immediately, it could take several days before this information could be provided. Another potential problem that must be considered is that of accounting for misplace files, etc. Consequently, it would be virtually impossible to provide this information in a timely and accurate manner without the aid of computer technology.

Accuracy within the CCH system is maintained by strict matching of the CDR documents with their respective fingerprint arrest cards as well as frequently auditing of the system for incomplete record information. The CCH system has the capacity to generate a computerized missing data list for every CDR document in the system, matching missing data to the authority responsible for the information. The New Jersey State Police CDR field staff will then use these audit sheets to retrieve the missing information. This auditing procedure insures a high degree of accuracy and record completeness.

As demonstrated, the computer provides a centralized data base, literally combining the resources of every criminal justice agency within the state of New Jersey.

The use of the romote terminals to supply criminal history information to criminal justice agencies has made it possible to; identify offenders in a more timely fashion, assist in moving the offender through the overcrowded court system quicker, and more easily monitor the offender in the state prison system. Last but not least, providing arrest profiles of offenders in custody has also made it safer for police officers who may otherwise not be aware of possible aggressive behavior of the individual in custody.

Fingerprint identification is one of the most important tools a crime investigator can employ. It is also one of the most boring, time-consuming, and unsuccessful endeavors an investigator uses. Fingerprints are formed by a human touching an object, and the oils and dirt on the human skin are left upon the object. Since every individual has a unique set of fingerprints, the fingerprint is a signature of the person. A fingerprint "lifted" at a crime scene (usually by applying a fine powder to the object touched) are photographed, and these photographs then compared to fingerprint impressions of file (either at the local office, state office, or the FBI's master library of prints). The search to match just one set of prints could require thousands of man hours and hundreds of dollars. The early computer attempts at fingerprint matching were largely unsuccessful because they used the same schema for matching as a human would use (a spatial approach for recognizing patterns). That is, the latentprint (to use police terminology) would be compared one-on-one with the fingerprints on file (Banner & Stock, 1971). These early computer matching systems were unsuccessful because of the malleability of human skin. The pressure distortions due to malleability of the skin make the fingerprint appear slightly different when taken at two different times (Moenssens, 1971). Whereas the human matcher could recognize and adjust for these slight variations in prints, computers using a scanning procedure could not recognize and match prints because of these pressure distortions.

What was needed for computer matching was a new schema for coding fingerprints which would work despite pressure distortions. The solution to this coding problem was first supplied by Sparrow (1982). Sparrow's system employed graph theory and topological spaces to code and identify certain characteristics of each fingerprint. Although all persons are different, the lines of every person's print form some type of ridge, delta, loop, or arch pattern. Sparrow's coding technique relied on starting at a specified plane in the print (dependent on type of print) and then determining numerically specific characteristics of each seperate print line. Using a ridge pattern as an example (similar to looking at a series of mountains one in front of the other), Sparrow's coding system relied upon starting at the apex of every ridge and then determining the specific

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characteristics of that line going in both directions from the ridge. Each type of characteristic possible (10 in all) was assigned a numerical value. After examining the characteristics of each line, a numerical code was produced, such as 01 03 73 11 11 08 08 01 43 44 33 (pg. 212). The lefthand number of each series identified the characteristics of the line leading from the left of the ridge, and the righthand number identified the characteristics of the line leading from the right of the ridge. In this example, there would be a total of 11 ridge lines. The computer would then find a matching sequence. Because pressure distortions would again affect the coding to some degree, a criteria of matching would be established, such as six of 11 codes agreeing. Deltas, loops, and arches would similarly be coded (deltas would use a three digit code, for example).

Based upon the research of Sparrow (1982) and others, one of the most dramatic breakthroughs in the field of police technology has developed with the advancement of Automated Fingerprint Identification Systems (AFIS). These new computerized systems are able to electronically read, classify, and store fingerprint data at high speed, saving many man-hours of tedious classification by technicians. The most dramatic breackthrough, however, is the ability to query the data base and compare latent fingerprints against identified prints stored in the data base.

The AFIS system consists of three subsystems. The first is composed of a control unit; an input system with a fingerprint reader (which reads the fingerprint into the system), and a monitor (which allows a technician to key in data and to adjust the image on the fingerprint reader). The second subsystem is the fingerprint matching subsystem which consists of the data base, the matching processor, and a control unit. The third subsystem consists of an optical storage disk which is used to recall the fingerprint image to the control console for comparison purposes. For example, when a search is requested, the system gives a high probability match score to a stored fingerprint, the operator of the system can bring up the image of this fingerprint on his/her monitor to compare it with his/her unknown print all without leaving his/her workstation.

Under the traditional classification of fingerprints, patterns were classified in subdivisions of loops, arches, and whorls, and then filed in cabinets with similar groupings of those subdivisions. AFIS uses fingerprint ridge endings, and ridge bifurcations (minutiae) and its relationship with neighboring minutiae, incorporating ridge counts between the minutiae to achieve a more accurate computerized pattern recognition between stored fingerprints and those to be searched against the data base. This searching method insures accurate computer matching.

When a fingerprint is searched for in the AFIS data base, AFIS will provide scores to a list of matching fingerprints. A technician then compares the highest scored pring selected to his/her latent print.

The major benefits to AFIS include; (1) it allows a high speed search of latent prints against a data base (at a rate of up to 12,000 prints per second), a feat that was not possible before AFIS, (2) it allows the search of a latent fingerprint against a data base of unsolved latent prints tying the two together, aiding in criminal investigations, (3) it allows the comparison of a known subject against the unsolved data base, and (4) it provides high speed classification and storage of arrest fingerprints.

An outstanding example of an achievement made possible with AFIS was identification of Richard Ramirez, the California night stalker. In this 1985 case, a latent fingerprint taken from an automobile linked to the night stalker was run through AFIS. The system scanned 380,000 sets of prints and within minutes selected ten possible matches. Heading the list was Richard Ramirez, who was apprehended and is now in jail charged with murder.

Fingerprints offer a high probability of conviction when used as evidence in an investigation. AFIS will deliver the identities of latent crime fingerprints and increase conviction rates of these crimes to the highest possible levels, providing a safer public environment.

This sytem will provide an outstanding police tool once established on a national level. Police departments having latent prints available with scores of unsolved criminal cases will now have a mechanism to identify those responsible for the crime.

The FBI uses a system similar to AFIS, called the Minutiae Based Automated Fingerprint System (AFIN; Buracher & Stover, 1984).

Being able to code and correctly identify fingerprints is only half of the problem in using fingerprints as evidence. The police have to be able to collect fingerprints. Several variables influence the collection of fingerprints, including pressure applied to the object, object touched (for example, smooth surfaces such as glass make for better impressions than do rough surfaces such as paper), and age of the print. One recent, and extremely promising technique for the collection of fingerprints is the laser (Dalrymple, Duff, & Menzel, 1977; Levinson, 1983; Ridgley, 1985). The FBI is using a continuous wave argon-ion laser to detect fingerprints. As an example of the sensitivity of the laser, the FBI recently detected the fingerprints of a German war criminal on a piece of paper which were over 40 years old.

One area in which computers are just beginning to have an impact on the field of policing is in simulation. Computer simulation in policing had its origins in Computer Aided Dispatch (CAD; Pitchess, 1971). In CAD, patrol officers have a remote terminal in their patrol vehicle which is linked with a central console in the dispatcher's office.

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Not only does CAD simplify communications between the dispatcher and the officers, CAD can also determine patrol allocation, area assignment, assign officers to incidents, and determine patrol assignments (Waterfield, 1977). Some systems even combine and link the police agency with the local fire and emergency medical services agencies (Caldwell, 1984).

The more advanced CAD systems can simulate and plan for a variety of potential situations the police may encounter, such as riots, public disturbances, robberies, homicides, etc., and have the computer provide a detailed analysis of how the patrol officers would respond to these situations in terms of manpower available, time to respond, etc. Administrators can use these simulations (most of which are simulated in real time) for patrol resource allocation and patrol workload analysis (Johnson, 1979; Hilmar, 1985), shift analysis and estimated manpower needs (Arnold & Lipsett, 1974), and selected traffic enforcement and management (Deitch, Goodson, & Johnson, 1985).

One of the most promising areas of simulation is in police training. At present, the most common use of computer simulation in training is in computer aided instruction (Flammang, 1979; Dennis, Flammang, & Walker, 1979; Flammang & Walker, 1981; Wilkenson, 1984). Computer aided instruction (CAI) has many advantages for the trainee. CAI can provide more realistic training scenerios for the trainee, approximating more closely street situations than can lecture techniques or film presentation. Other advantages of CAI include immediate feedback on performance so the cadet can easily determine what they did correctly or incorrectly and make appropriate adjustments in their solutions, provide a variety of scenerios so the cadet can expand their decision making skills to a wide variety of situations (i.e., when and under what circumstances a person may be stopped, search of person, probable cause, use of force, etc.), and unlimited practice time. In addition, the cadet can return to any part of the lesson they need to study more, the cadet can work at their own pace, the CAI program can easily be modified for individual instruction or special training needs, and the system is portable for use outside of a central training location.

Possibly one of the most promising uses of simulation is in an area which is the most difficult for police officers, that of whether to shoot or not shoot. In recent years, police training programs have been simulating situations where the trainee must decide whether to shoot or not shoot. In a shoot/don't shoot exercise, the officer is confronted with a situation they might face while on patrol, and the officer has to make a split-second decision as to shoot or not to shoot. In the past, to make the exercise realistic, a team of actors had to be employed to play out the characters in the various situations and the necessary props purchased. The officers would then be taken, one at a time, through the exercise and their performance evaluated by the trainer. This procedure, although somewhat effective, was prohibitive to most departments because of the time and cost involved. Recent efforts are underway by this author and others to computer generate these shoot/don't shoot exercises. In these simulations, the officer is placed either in front of a CRT screen or in front of a rear projection slide projector screen with a computer "wand" as a firearm. In either case, the computer displays a situation which requires a shoot/don't shoot decision by the officer. If the decision is to shoot, the officer points the "wand" to the proper coordinates and "fires". After "firing", the scenerio is completed, so the officer knows immediately if their decision was correct. The computer system scores accuracy and time to fire, and can record whether the officer would have reacted in time or would have been shot. In addition to financial considerations, there are many other benefits to the shoot/don't shoot simulation. Departments can modify the exercises to their own personal needs and requirements, several officers can be involved in the exercise at the same time, and the programs can be modified to review the facts and circumstances surrounding an actual shooting (thus useful for shooting review boards in actual cases), to name just a few.

A final area this paer will discuss concerning computers and the police is in the area of robotics. The only common use of robots at the present time is in the field of bomb disposal. The New York City Police Department, for example, uses a robot to investigate and disarm potential explosive devises. These "bombots" (author's contraction) are remote operated and can perform the same disarmament functions that a human can, without the human risk. Other than for bomb disposal duties, robots are not presently being used in policing. Robots are being considered, however, for performing certain police functions, such as routine patrol duties, entering hostile environments to dispense tear-gas or other chemical debilitating agents, to monitor and enter hostage situation locations, and to guard cell blocks of state prisons. While only in the infant stages, the use of robots in policing has a secure future.

As shown in this paper, computer systems and human factors engineering will play a major role in policing in the years to come. We have reviewed only some of the areas where human factors engineering has impacted the police. There are many more areas that we have omitted and many areas where there is a real need for human factors engineering. Albeit slow, police agencies are making progress and are using the technology and data available to improve their operations.

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